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E. B. Sugden Esq
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A MEMOIR,

ADDRESSED TO

THE SOCIETY FOR THE ENCOURAGEMENT

OF

ARTS,

MANUFACTURES, AND COMMERCE,

ON

THE PLANTING AND REARING

OF

FOREST-TREES.

BY WM. WITHERS, JUN.

SECOND EDITION.

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1827.

June 25 1906

MEMOIR.

TO ARTHUR AIKIN, ESQ.

Secretary to the Society for the Encouragement of Arts, Manufactures, and Commerce.

SIR,

THE principal object of the present memoir is, to communicate to the Society the result of several experiments on manuring land for forest-trees; to demonstrate the absolute necessity of deeply ploughing or trenching it previous to planting; and of keeping it clean, and free from weeds, for some years afterwards. I had myself been long satisfied, that this latter method was *indispensable*, to insure success upon land such as is usually selected for planting, and believed most other

planters were of the same opinion; but notwithstanding all that has been said and written on the subject, and though proofs of the utility of trenching and cleaning, and of the loss and disappointment attending a contrary practice, are daily and hourly presenting themselves to observation, there are great numbers of gentlemen who, with these proofs before their eyes, still persist in attempting to raise plantations by merely digging holes and putting in the trees, and then leaving them to their fate amongst the whins, the fern, or the heath, the weeds, or other rubbish, by which they are surrounded, and by which the more valuable trees are, in most cases, entirely destroyed in a few years.

I will now state as concisely as possible the result of my own experience as to the utility of trenching land previously to planting, and keeping it clean afterwards.

In the year 1811, I planted a piece of land in this parish, containing about five acres, adjoining my house. I call this plantation No. 1. The land had been recently inclosed

under an Act of Parliament, and at the time I planted was covered with heath and whins. I caused large holes to be dug, in which I planted Scotch fir, and a proper assortment of deciduous trees. The fir succeeded pretty well, but the other trees made no progress; and although I yearly filled up the vacancies occasioned by death and decay, I found at the end of four or five years that all the trees but the Scotch fir, with very few exceptions, were dead or in a dying state. I then had all the ground trenched, and the vacancies filled up with oak, ash, chesnut, elm, and other deciduous trees, and have kept it regularly hoed and free from weeds ever since. The consequence has been, that the last-mentioned trees have made such a rapid growth, that I have been enabled to clear away the greater part of the fir; and the remainder must be taken out in another year or two, to give room for the other trees. One mountain ash, which had escaped the deadly effect of the heath and whins, gave a decided proof of the advantages of trenching and cleaning the land:—this tree had barely kept alive, not making more than two or three inches of wood

in a year; but in the year following the trenching, it threw out two leading shoots, the smallest of which I cut off at the Michaelmas, when it measured six feet two inches—the growth of one year.

In the spring of 1819, I planted another piece, No. 2, containing about half an acre, adjoining No. 1. This land was trenched two feet deep, and has since been kept perfectly clean; and so great is the advantage of preparing the land properly in the *first instance*, that the trees on No. 2 are now much superior to those on No. 1, planted eight years before, although the latter have had the benefit of hoeing during the last nine or ten years.

It is worthy of remark too, that, in this last plantation (No. 2), the deciduous trees have far outstripped the Scotch fir in growth; and I believe it is universally the case, that, where land is *properly prepared* and *kept clean*, deciduous trees will make much more wood than firs: and that, where the hole-digging system is adopted (unless the land is very good), the firs are the only trees that will succeed.

The same year in which my plantation, No. 1, was made, two pieces of land not one hundred yards from mine were planted; one by the late Mr. Richard Gurney, and the other by Mr. Hardy. Mr. Gurney's land was broken up very deep with a four-horse plough, and large holes were dug amongst the heath in Mr. Hardy's. A good assortment of forest-trees was planted in both; but, at the expiration of three years, Mr. Hardy, finding many of his trees dead and the others making little or no progress, trenched his land, and filled up the vacancies, and has since kept it regularly hoed and clean from weeds. Mr. Gurney's has been entirely neglected, and the heath and whins have been suffered to grow to the height of several feet. The consequences are, that Mr. Hardy has at this time a fine flourishing plantation; while in Mr. Gurney's (which is divided from Mr. Hardy's by the road only) all the deciduous trees are dead, and nothing remains but Scotch and larch firs.

A plantation made by Mr. Mott, about half a mile further on towards Cromer, where

the land was properly ploughed and planted but has been neglected since, affords another proof of the necessity of cleaning the land and keeping it clean. The trees have been declining yearly, and nothing now remains but a few scrubby Scotch firs, although an abundance of other trees were originally planted with them.

Different motives operate on gentlemen to prevent their keeping young plantations clean. Some think it not only unnecessary but injurious to the young plants, the weeds they say keeping the land moist and shading the roots of the plants from the heat of the sun, while stirring the ground lets in the drought. Others object to the expense (about sixteen shillings an acre per annum for three years); and almost all, I believe, are apprehensive that, by keeping the land free from weeds, the cover for game would be destroyed.

As to the first of these objections, nothing can be more palpably erroneous. It is well known, that nurserymen spare no pains or expense to keep their ground free from weeds; and gardeners invariably do the same, as the

most effectual means of promoting the growth of their plants. It is evident, that every weed which is suffered to gro v must rob the ground of a portion of the food which the plants would otherwise receive; and this is a consideration of the *utmost importance, when it is remembered, that during the first two or three years of the growth of young trees, they must be principally indebted to the superficial soil for their nourishment:* and, moreover, land which is suffered to get *hard* cannot imbibe so much of the atmospheric moisture as it would receive, if the surface were kept in an open and *loose* state by the hoe. It is quite a mistake to suppose, that stirring land in dry weather lets in the drought: on the contrary, it is the only effectual means of keeping it in a moist state, the loose mould detached by the hoe operating as a shade upon the soil beneath. Let sand about two inches thick be laid upon a piece of broken ground, and in the hottest weather moisture will be found below, while the ground adjoining (not shaded by the sand) will, if not pulverised, be hard and dry for nearly a foot in depth; and hoeing produces the same effect as the sand. As to any other shade than that produced by

hoeing, the plants want none; and the more powerful the heat of the sun, the faster they will grow even upon the lightest soils. As to the expense of hoeing, what can be the object of sixteen shillings an acre for three years, compared with the difference in value between a good and a bad plantation—between fine growing plants of oak, ash, and chesnut, and worthless Scotch firs? Most gentlemen plant for future profit. Planting we all know cannot be done in the *worst* manner without expense; and if the extra cost which *insures* a profitable crop be spared, the object is entirely defeated, and the money which is expended wholly thrown away. It would be quite as reasonable for a farmer to incur all the cost of preparing his land for turnips, and then to lose his crop rather than be at the expense of hoeing it; as it is for a gentleman to lay out his money in putting trees into the ground, and then omitting to expend such an additional sum as is *absolutely necessary* to make them productive.

The objection about game is quite as untenable as the others. I admit that heath

and whins will afford better cover than land in a clean state; but this will not last many years under Scotch firs, which it is well known will destroy all vegetation beneath them. A good permanent cover is not to be had in a plantation without *underwood*, and this cannot be made to grow amongst heath and whins, nor unless the ground be kept perfectly clean. To hoe young plantations is, therefore, not less necessary to obtain a good cover for game, than it is to insure a profitable crop of timber.

I have hitherto confined my observations to cases in my own neighbourhood, but I could cite numerous other instances there, and even in other parts of the kingdom, of the total failure of plantations for want of trenching and cleaning, and of the success of others where that treatment has been adopted. Indeed a volume might soon be filled on the subject. The first person, I believe, who introduced the hoe into young plantations in this county was my friend, MR. SANDYS of *Wells next the Sea*, who began to plant upon the *Holkham* estate for MR. COKE about forty-six years ago, and who has succeeded in raising for that gen-

tleman, upon a poor soil, nearly one thousand acres of the most flourishing and valuable trees in the kingdom; but I sincerely believe, that *if these trees had been assisted in their early growth by manure*, MR. COKE'S estate would have been worth at least one hundred thousand pounds more than it now is. This may be regarded as a bold assertion, but I am convinced that the estimate is below the mark. These plantations are from twenty-four to forty-six years old, which gives an average of thirty-five years. Now if we add only three pounds an acre per annum for *extra* growth during that period in consequence of manure (which is a mere trifle compared with the actual increase), it will amount to more than one hundred pounds an acre.—*See Appendix, No.* 1. From MR. SANDYS I first learned the necessity of trenching and cleaning land for trees; and the reasons which I have before urged, to show that necessity, have been mostly derived from him: and I think it no more than just to offer this testimony to the merit of a gentleman, who is no less distinguished for his ability as a planter, than he is for the taste which he uniformly displays as

a landscape-gardener, in ornamenting and beautifying gentlemen's estates.

I will now proceed to show the effect of MANURE upon the growth of forest-trees.

In the year 1818 I purchased about an acre of land, No. 3, adjoining the plantation, No. 1. This land was originally heath, and was allotted under the Act of Parliament before mentioned; but instead of being planted, was cultivated and cropped with corn, and other agricultural crops, and when I took it was in a *rich state*. I converted the greater part into a garden, and planted about one rood with forest-trees, having *first* trenched the land about two feet deep: since then it has been kept thoroughly clear from weeds. These trees are now in the most prosperous state; and taken altogether far exceed those adjoining which were planted seven years before, and are also much better than the plantation, No. 2, which was made *without manure* in the year following, making every allowance for the additional growth of one year. Some of the oaks are twenty feet in height, and measure eighteen

inches round at the bottom, and the other trees are equally good.

In the same year, 1818, I planted several trees in borders well prepared near my house, No. 4; and, being intended for ornament and shelter, more than ordinary pains were bestowed upon them. This labour they have amply repaid. There are elms, oaks, and locusts, from nineteen to twenty-eight feet high, which girt in proportion; while trees of the same description, planted at the same time upon adjoining borders not so well prepared, are not near the size.

In 1820, I purchased some more heath-land near that above mentioned. I caused the heath or ling to be pared off and burnt, in the method recommended by Mr. Cobbett in his "Year's Residence in America;" and in the following year I planted about twelve acres with forest-trees. Upon part of this twelve acres, No. 5, I had the *flag-ashes* spread before the trees were planted, and removed the ashes from the remaining part, No. 6. In the first year, the trees upon the land where the ashes had

been spread, showed a most decided superiority over the trees where the ashes had been removed, and the difference *has become more manifest every succeeding year*. It is now indeed so very great, that it is scarcely credible it should have been produced by such a cause only; but that is the fact, the land being precisely of the same quality, treated in every respect in the same way except as to the ashes, and planted at the same time with the same kind of trees. The trees on the one part are nine or ten feet high, and so close together that they must be pruned and thinned considerably this year; while those on the other part are not more than three or four feet in height, and by no means cover the ground: and I verily believe, that the former will be better at ten years old than the latter will at twenty or twenty-five. In order however to enable the Society to form their own judgment on the subject, I send specimens of the trees from both parts of the plantation.

Upon another part of the above twelve acres from which the flag-ashes were removed, No. 7, I spread some *marl* and *brick-earth*,

and the trees there grow quite as vigorously as those which had the benefit of the flag-ashes; and from this circumstance I am convinced that marl or brick-earth is very serviceable in promoting the growth of trees upon poor light soils. Specimens of these trees are also sent.

Having thus witnessed the efficacy of manure in the several instances before mentioned, I determined never to plant another tree without first manuring the ground. In the summer of 1823, I hired some *heath*-land, No. 8, of the Fishmonger's Company of London, for forty years, under an agreement to plant fifteen acres, having the benefit of the plantation during the term, but leaving the Company one hundred trees an acre at the end of it. It was obvious that the faster I could make the trees grow, the better they would pay me; and with the above experience before me, I resolved to manure the land with both *marl* and *muck*. I caused the land to be double ploughed first with two horses, and then with four, following in the same furrow, by which means the soil was stirred to the depth of eighteen or twenty inches. I fortunately

found the remains of an old marl-pit in the piece, from which I barrowed and spread twenty cart-loads per acre. This I suffered to lie and pulverize all winter: and in the following spring (viz. in April, 1824), I carried on and spread twenty loads per acre of good rotten muck, ploughed it in, and planted the trees, which consisted of oak, ash, elm, chesnut, and black Italian poplar, with a few of other sorts.

They took exceedingly well, and many of them made vigorous shoots the first summer; the second year they nearly covered the ground; but during this summer their growth has been prodigious: many of the ash trees have made shoots upwards of five feet long, and, upon an average, I think both they and the oaks have increased this year full three feet in height. The chesnuts have not done so well; but the poplars have made such progress, that they have actually the appearance of trees eight or nine years old. The severe drought, which has burnt up trees on land in a poor and foul state, has had the effect of adding considerably to the growth of these.

They have never had the appearance of wanting moisture, although not a drop of rain fell upon them for a period of several weeks during the very hottest part of the summer. This luxuriant growth I attribute to the deep ploughing, to the highly manured state of the land, and to its being constantly kept clean and loose upon the surface by means of the hoe; and I firmly believe, that when land is in this state, the weather in England can never be too hot for forest-trees.

It is necessary to say something about the expense of doing this, as I am aware that an objection would be raised on that ground by almost every gentleman to whom this mode of planting might be recommended. With the view of exciting attention to the subject, I have put up a board in the plantation by the road-side, enumerating all the particulars, which I will here copy:

Experimental Plantation, showing the effect of manuring Land for Forest-Trees. Planted in April, 1824.

	COST PER ACRE.		
Twenty loads of marl at 15*d.*	£1	5	0
Twenty ditto of muck at 5*s.*	5	0	0
Ploughing the land.....	1	0	0
Trees, carriage, and planting	7	10	0
Total cost per acre £14	15	0	

The ploughing I think I have put ten shillings too low, and therefore the total cost per acre may be stated at fifteen pounds five shillings.

This may and will be thought by many to be a great sum: but a nurseryman will not plant with *good* trees, and fill up for three years, under ten pounds an acre, *exclusive of ploughing;* and observe, that *when you manure,* you never want to fill up, for all the trees are sure to take, and instead of filling up you may, after the third year, take out and transplant at least a tenth part of them. Look too at the rapid manner in which the trees grow, and how much more quickly you get a plantation into a *paying state,* than you do when

trees are planted without manure. I know hundreds of acres of land, which were planted from fifteen to twenty years ago at an expense of more than ten pounds an acre, the trees on which would not now be valued at the original cost of planting them; whereas, had one third more been expended in manuring and properly preparing the land, they would have been worth from fifty to one hundred pounds an acre.

A regard to economy in planting is sometimes carried to too great a length. A gentleman (ADMIRAL WINDHAM), about eight miles from me, planted, in the same year in which I planted part of No. 8 (1824), forty acres of land upon a cheap plan. Some Scotchmen persuaded him that neither trenching, ploughing, nor cleaning was necessary: that just to raise a flag, by making a triangular incision, and putting in a seedling plant and pressing it down with the foot, was quite sufficient to raise in quick time a flourishing and valuable plantation; and that, as to the grass and weeds, they would keep the trees warm and also keep out the drought—they would in fact

be a source both of heat and moisture: and all this was to be done for three pounds ten shillings an acre. Most gentlemen are disposed to listen to any proposal for doing work cheaply: accordingly the Scotchmen were employed, and planted the forty acres. But the plantation is a *total faiture*. The trees (that is, such of them as are alive) are almost entirely choked up with grass and weeds, and are literally worth nothing. The sum of three pounds ten shillings an acre, amounting altogether to one hundred and forty pounds, is therefore as completely thrown away, as if it had been cast into the sea. Besides the loss of the money, there is the loss of time (which cannot be recovered), the rent of the land if it were worth any thing, and the mortification of having a favourite object defeated; and to all this gentlemen expose themselves by attempting to effect improvements parsimoniously.

Farmers of poor land generally fall into the same error: they do not perceive, or are unwilling to believe, that it is the trifling expense of a little *extra* manure, that occasions

all the difference, upon this sort of land, between an abundant and a short crop; but that such is the case, I have frequently observed in my own immediate neighbourhood. I have myself grown upon poor heath-land nine, ten, and in one instance eleven coombs two bushels of wheat an acre, while the adjoining lands of the same description and quality have never exceeded six; and this has been effected merely by laying on an additional quantity of eight loads of muck per acre. My neighbour has put on twelve and I twenty loads per acre: he has grown six coombs and I have grown ten. It does not appear to be considered, that, in high farming, the muck is the *only* additional part of the expense, the tillage, seed-corn, rent, poor-rates, and labour, being the same whether you grow six coombs or ten. The same observations will apply to trees, which are sure to pay for all the *extra* cost and labour bestowed upon them.

I cannot conclude without stating a circumstance, which exemplifies in the strongest manner the power of manure when applied to a naturally fast growing tree. I allude to the

LOCUST, one of which I planted upon a border in plantation, No. 1, in the year 1821; and being intended for ornament, it was planted with manure. In 1824 I cut it down; and, in the following summer, it threw out several shoots, one of which at the autumn measured ten feet in height. The following year it increased six feet, and measured six inches round at the bottom; but the upper branch having been blown off, I cut the tree down and sent it to MR. COBBETT, at 183, *Fleet-Street*. I have requested him to send it to the Society.

This year I cut down another *locust*, which was planted *with manure* at the same time upon a soil still worse, one of the shoots from which has grown to the astonishing length of eleven feet. This I have also sent to the Society.

The success of a plantation almost entirely depends upon the trees being well *set off*. On good land, this will be the case without any other assistance than trenching and cleaning; but, on poor land, *manure* also is necessary.

This will enable the plants to strike out numerous and vigorous roots, by which their food is obtained. I am aware that an opinion is entertained, that plants receive a considerable part of their nourishment from the air; but if this be so, it can only be through the medium of their branches and leaves, as being so many channels or vehicles through which that nourishment is conveyed or imbibed: and if manure increases the size and number of these branches and leaves, as it certainly does, it follows that plants are thereby furnished with additional means of obtaining food, it being obvious, that a tree, with luxuriant branches, must possess the power of taking up food from the atmosphere in a much greater degree than a feeble plant, with but little wood and few leaves; and, therefore, manure is equally beneficial to plants, whether they derive their nourishment partly from the air, or wholly from the soil.

Considering the zeal and expense with which all agricultural improvements have been adopted and pursued, it is rather surprising, that gentlemen should have devoted so little

of their money and attention to the no less important science of planting, and stimulating the growth of forest-trees; but this *lukewarmness* may to a certain extent be accounted for. Most gentlemen are induced to plant as *cheaply* as possible, under the impression that they are *sinking money for the benefit of their posterity*, or that the *period of return is so remote and uncertain*, that it is scarcely equivalent to the expense they have parsimoniously permitted themselves to bestow; but if they could once be convinced, that, by a more *liberal* expenditure, they might themselves obtain a speedy and certain return, one of the great obstacles to an improved and profitable mode of planting would be removed, and we might hope to see the country again enriched and embellished, as it evidently was in *former* times, by forests of oak and other valuable timber, instead of witnessing, as we now do, innumerable tracts covered with perishable firs, which are worthless in comparison with other trees, and repulsive to the eye of taste. I am the more inclined to indulge in this anticipation, and to believe that so desirable an event will happen if the prejudices and opinions which I

have alluded to be removed, from the circumstance, that most gentlemen are in the habit of adopting the mode of culture I recommend upon other occasions. No one thinks of planting fruit-trees, even in a garden, without manure; and no good farmer attempts to raise a fence, upon ordinary land, without well mucking it at the time he plants the layer. Fences so raised will make greater progress in one year, than they will in three without manure; and there is no reason why the same stimulus should not prove equally beneficial when applied to forest-trees. I hope, however, that some gentleman, with better means than I possess, will give the experiment a fair trial upon a large scale. It may be difficult, in some situations, to obtain sufficient muck; and it is therefore deserving of consideration, whether artificial manures will not answer the purpose. I am of opinion that they will; but I intend to try some experiments on the subject in the ensuing season, the result of which I will communicate to the public.—*See Appendix, No.* 3. I am, Sir,

Your most obedient servant,

Holt, W. WITHERS, Jun.

Oct. 28, 1826.

APPENDIX.

No. 1.

NOTE REFERRED TO IN PAGE 14.

THREE pounds an acre is only four pence halfpenny per rod, which the experienced observer will consider much under the annual difference between fast and slow growing trees.

Since writing the Memoir, I have been favoured by a friend with the twenty-sixth volume of the Transactions of the Society of Arts, containing a communication from MR. CHARLES WAISTELL, and several ingenious tables constructed by him, for showing the progressive annual increase in the growth of trees. MR. WAISTELL states, from his own experience, from the best information he could obtain of his acquaintance, and from various authors, that the increase in the circumference of trees is generally from one to two inches annually, and from twelve to eighteen inches the annual increase in height. Now if trees planted upon poor land, without manure, will annually increase twelve inches in height and one inch in circumference; it may I think be fairly assumed, that, upon land *well manured*, they will increase annually at least eighteen inches in height, and two inches in circumference. The latter growth will produce six times

as much timber, in any given period, as the former. A tree, thirty-six years of age, growing twelve inches annually in height and one inch in circumference, will contain only five feet and nine parts of an inch of timber *(vide Appendix, No. 5, Table I.)*; whereas, when growing at the rate of eighteen inches in height and two inches in circumference, it will contain thirty feet four inches and six parts of an inch *(Table II.)*. Some of the tables show the number of trees to be cut out in the thinning of woods, and the number left standing, at every period of four years, from twenty up to sixty-four years; and the number of feet they will respectively contain at those periods. From these tables it appears, that if trees annually increase twelve inches in height and one inch in circumference, there should be cut out per acre during thirty-six years*

	1882	trees containing	3036 feet,
and left standing	840	trees containing	4252 feet,
being totals of . .	2722	trees containing	7288 feet;

while the contents of trees taken out and left standing in woods, which have increased at the rate of eighteen inches in height and two inches in circumference, will for the same period be as follows :†

Taken out	2349	trees containing	10,855 feet.
Standing	373	trees containing	11,314 feet.
Total	2722	trees containing	22,169 feet,
			7,288
Difference *per acre* from *extra* growth			14,881 feet,

* Table III. † Table V.

If the calculation be pursued for the whole eriod of sixty-four years, the result will be as follows:

	Table III. FEET.	*Table V.* FEET.
Contents of trees cut down in 60 years	8,897 ..	26,429
Ditto of trees left standing for 64 years	7,537 ..	20,138
	16,434	46,567

Difference in quantity of timber per acre in favour of No. 5, 30,133 feet.

I assume, as a fact proved by my own experience, that the difference in the growth of trees manured and not manured very considerably exceeds six inches in a year. The trees in Mr. Coke's one thousand acres of plantation may or may not have averaged in growth more than twelve inches yearly; but supposing they have not made more than twelve inches, when, if manured, they would have made eighteen (and I am of opinion that whatever their growth may have been, the difference would in proportion be equally great), Mr. Coke's loss, by not manuring his land, will be far beyond the estimate I have made in the Memoir. His trees have on an average been planted nearly thirty-six years. Now at the end of that period it will appear, by reference to Mr. Waistell's tables, that if these trees had made twelve inches in height yearly, he might have cut 3036 feet of timber *per acre*, and have left standing 4250 feet; but, if they had made eighteen inches per year instead of twelve, he might have cut 10,855 feet of timber *per acre*, and have had now remaining 11,314 feet per acre. The *extra* produce of the 1000 acres would, therefore, have been 14,881,000 feet of timber, which, at one shilling

only per foot (and the least valuable timber sells at a higher price), would amount to the enormous sum of £744,050. Surely these calculations are worthy the consideration of those, who, though regardless of their own emolument (if any such there be), are yet desirous of finding *profitable* employment for the poor. Might not the public forests, and the vast tracts of waste land throughout the kingdom, by the judicious application of the unemployed manual strength of the country, be made an inexhaustable source of national and individual wealth?

No. 2.

ADMEASUREMENT OF TREES REFERRED TO IN THE FOREGOING MEMOIR.

No. I. North Side of Carriage-Road.

1. Wych Elm, planted in 1811.
Height, 21 feet 8 inches.

Inches round, ... 21 at bottom. 19 at one foot up. 13 at six feet.

2. Oak, planted in 1811.
Height, 23 feet 5 inches.

Inches round, ... 20 at bottom. 16 at one foot up. 13 at six feet.

3. Ash, planted in 1811.
Height, 18 feet 8 inches.

Inches round, ... 14 at bottom. 11 at one foot up. 9 at six feet.

4. Sycamore, planted in 1811.

Height, 20 feet.

Inches round, ... { 16 at bottom. / 14 at one foot up. / 11 at six feet.

5. Locust, planted in 1821, and standing within 8 feet of the four last-mentioned trees.

Height, 21 feet.

Inches round, ... { 15 at bottom. / 14 at one foot up. / 10½ at six feet.

No. III. In Plantation adjoining No. I., being a continuation of North Side of Carriage-Road.

Planted in 1818.

6. Oak. Height, 20 feet.

Inches round, ... { 18 at bottom. / 14 at one foot up. / 10 at six feet.

7. Oak. Height, 18 feet.

Inches round, ... { 15 at bottom. / 11¾ at one foot up. / 9 at six feet.

8. Spanish Chesnut. Height, 18 feet.

Inches round, ... { 24 at bottom. / 20 at one foot up. / 13 at six feet.

9. Locust, planted in 1821.

Height, 19 feet 6 inches.

Inches round, ... { 14 at bottom. / 12½ at one foot up. / 9¾ at six feet.

No. IV. Border of Grass-plat.

Planted in 1818.

10. Chichester Elm. Height, 28 feet 4 inches.

Inches round, ... { 23 at bottom. 19 at one foot up. 16 at six feet.

11. Chichester Elm. Height, 23 feet 7 inches.

Inches round, ... { 23 at bottom. 18 at one foot up. 14½ at six feet.

12. Chichester Elm, on contiguous border not so well prepared.

Height, 20 feet.

Inches round, ... { 16 at bottom. 12 at one foot up. 9½ at six feet.

13. Luccomb Oak. Height, 19 feet 9 inches.

14. Hertfordshire Elm. Height, 18 feet.

Inches round, ... { 17 at bottom. 14 at one foot up. 9¾ at six feet.

Border of South Walk.

15. Spanish Chesnut. Height, 17 feet 8 inches.

Inches round, ... { 20 at bottom. 18 at one foot up. 10 at six feet.

16. Spanish Chesnut. Height, 16 feet 6 inches.

Inches round, ... { 21 at bottom. 18 at one foot up. 8½ at six feet.

17. Locust, planted in 1821, and standing within twelve feet of the two preceding trees.

Height, 19 feet 2 inches.

Inches round, ... { 19 at bottom. 16 at one foot up. 11 at six feet.

By Green Door.

18. Chichester Elm, planted in 1818.

Height, 28 feet 9 inches.

Inches round, ... { 23 at bottom. 18 at one foot up. 15 at six feet.

No. 3.

NOTE REFERRED TO IN PAGE 28.

I assume, that five pounds an acre is a proper sum to lay out for manure, being equal to twenty loads of muck as I can purchase it, including carriage. I therefore propose to manure after the rate of five pounds an acre, with lime, with rape-cake, and with ground rape-seed separately; and I also intend to try salt, at the rate of from ten to twenty bushels per acre.

No. 4.

TREES SENT TO THE SOCIETY.

From Plantation, No. I.

Shoot of a Locust Tree cut down in April last, 11 feet. The tree was planted in 1821.

Shoot below the graff of a Rose Acacia, 8 feet 9 inches.

Four lateral shoots of Locusts, from 7 feet to 9 feet 3 inches.

From No. V. planted in 1820 *upon Land spread with Flag-Ashes.*

Ash,	height	6ft.	11in.	length of leading shoot	2ft.	0in.
Oak,	....	7	3	.....	2	9

From No. VI. planted in 1820 *without any Manure.*

Ash,	height	5ft.	3in.	length of leading shoot,	0ft.	8in.
Oak,	....	4	0	.....	1	1

From No. VII. planted in 1820 *upon Land which had been marled.*

Ash,	height	9ft.	0in.	length of leading shoot,	1ft.	0in.
Oak,	....	10	0	.....	2	6

From No. VIII. planted in 1824, *upon Land manured with twenty Loads of Muck and twenty Loads of Marl per Acre.*

Ash,	height	6ft.	5in.	length of leading shoot,	4ft.	0in.
Ash,	....	6	1	.....	3	7
Oak,	....	6	6	.....	3	2
Oak,	....	6	0	.....	4	0
Black Italian Poplar.		10	5	.....	3	6

No. 5.

MR. WAISTELL'S TABLES RESPECTING THE GROWTH OF TIMBER.

Published in the 26th vol. of the Transactions of the Society of Arts.

CALCULATIONS, showing every fourth year from 12 to 100, the progressive annual increase in the growth of trees, and gradual decrease in the rate per cent. per annum, that the annual increase bears to the whole tree.

The whole height of the trees is taken to the top of the leading shoot, and the girt in the middle; but no account is taken of the lateral branches.

If trees increase twelve inches in height and one in circumference annually, their increase will be as undermentioned: viz.

TABLE I.

Years old & ft. high.	Girt.	Contents.			Years old & ft. high	Girt.	Contents.				One year's increase.				Rate per cent. of increase.
	inch.	ft.	in.	pts.		inch	ft.	in.	pts.	sds.	ft.	in.	pts.	sds.	
12	1½	0	2	3	13	1 5/8	0	2	10	3	0	0	7	3	26·8
16	2	0	5	4	17	2 1/8	0	6	4	9	0	1	0	9	19·9
20	2½	0	10	5	21	2 5/8	1	0	0	8	0	1	7	8	15·7
24	3	1	6	0	25	3 1/8	1	8	4	1	0	2	4	1	13
28	3½	2	4	7	29	3 5/8	2	7	9	1	0	3	2	0	11
32	4	3	6	8	33	4 1/8	3	10	9	6	0	4	1	6	9·67
36	4½	5	0	9	37	4 5/8	5	5	11	5	0	5	2	5	8·5
40	5	6	11	4	41	5 1/8	7	5	8	10	0	6	4	10	7·6
44	5½	9	2	11	45	5 5/8	9	10	7	9	0	7	8	9	6·96
48	6	12	0	0	49	6 1/8	12	9	2	3	0	9	2	3	6·38
52	6½	15	3	0	53	6 5/8	16	1	10	2	0	10	10	2	5·9
56	7	19	0	8	57	7 1/8	20	1	1	7	1	0	5	7	5·4
60	7½	23	5	2	61	7 5/8	24	7	6	6	1	2	4	6	5·1
64	8	28	5	4	65	8 1/8	29	9	7	0	1	4	3	0	4·76
68	8½	34	1	4	69	8 5/8	35	7	8	11	1	6	4	11	4·49
72	9	40	6	0	73	9 1/8	42	2	6	4	1	8	6	4	4·2
76	9½	47	7	6	77	9 5/8	49	6	5	2	1	10	11	2	3·98
80	10	55	6	8	81	10 1/8	57	7	11	9	2	1	3	9	3·79
84	10½	64	3	8	85	10 5/8	66	7	7	8	2	3	11	8	3·6
88	11	73	10	4	89	11 1/8	76	5	11	1	2	7	7	1	3·5
92	11½	84	5	9	93	11 5/8	87	3	4	0	2	9	7	0	3·3
96	12	96	0	0	97	12 1/8	99	0	4	6	3	0	4	6	3·15
100	12½	108	6	0	101	12 5/8	111	9	6	8	3	3		8	3

If trees increase eighteen inches in height, and two inches in circumference, annually, their increase will be as undermentioned: viz.

TABLE II.

Age of Trees.	Height.	Girt.	Contents.			Age of Trees.	Height.	Girt	Contents.			One year's increase.			Rate per cent. of increase.
	ft.	in.	ft.	in.	pt.		feet	inch	ft.	in.	pt. sd.	ft.	in.	pt. sd.	
12	18	3	1	1	6	13	19½	3¼	1	5	1 0	0	3	7 0	26·5
16	24	4	2	8	0	17	25½	4¼	3	2	4 0	0	6	4 0	19·8
20	30	5	5	2	6	21	31½	5¼	6	0	3 6	0	9	9 6	15·6
24	36	6	9	0	0	25	37½	6¼	10	2	0 6	1	2	0 6	13
28	42	7	14	3	6	29	43½	7¼	15	10	6 0	1	7	0 0	11
32	48	8	21	4	0	33	49½	8¼	23	4	8 0	2	0	8 0	9·6
36	54	9	30	4	6	37	55½	9¼	32	11	7 6	2	7	1 6	8·5
40	60	10	41	8	0	41	61½	10¼	44	10	3 6	3	2	3 6	7·6
44	66	11	55	5	6	45	67½	11¼	59	3	10 0	3	10	4 0	6·9
48	72	12	72	0	0	49	73½	12¼	76	7	1 0	4	7	1 0	6·3
52	78	13	91	6	6	53	79½	13¼	96	10	11 6	5	4	5 6	5·8
56	84	14	114	4	0	57	85½	14¼	120	6	8 6	6	2	8 6	5·4
60	90	15	140	7	6	61	91½	15¼	147	9	2 0	7	1	8 0	5
64	96	16	170	8	0	65	97½	16¼	178	9	4 0	8	1	4 0	4·7

Mr. Waistell's Explanation of the Construction of Tables I. and II.

To render the preceding tables easy to be understood by persons not accustomed to calculations, I will state the process of the operations in the first line of table II.

The height of trees at 12 years of age is supposed to be 18 feet to the top of the leading shoot, and 24 inches in circumference at the ground, consequently, at half the height, the circumference is 12 inches, one-fourth of this, being 3 inches, is called the girt. The girt, being squared and multiplied into the height, gives 1 foot 1 inch and 6 parts for its contents. At 13 years old, the tree will be 19½ feet high, 26 inches in circumference at the ground, and 13 inches at half the height; one-fourth

of 13 gives $3\frac{1}{4}$ inch for the girt. This, squared and multiplied into the height, gives 1 foot 5 inches and 1 part for the contents. Deduct from this the contents of the tree at 12 years of age, and there remains 3 inches and 7 parts, which is the increase in the 13th year. Then reduce the contents of the tree when 12 years old, and the increase in the 13th year, each into parts, dividing the former by the latter, and the quotient will be 3·76; by this number divide 100, and the quotient is 26·5, which is the rate per cent. of increase made in the 13th year; consequently, whatever the tree might be worth when 12 years old, it will, at the end of the 13th year, be improved in value after the rate of £26 10*s.* per cent., or, in other words, that will be the interest it will have paid that year for the money the tree was worth the preceding year.

At every succeeding period, both in this table and table I., the like process is gone through.

Mr. Waistell's Observations on Tables I. and II.

The preceding tables furnish us with the following useful information: viz.

1. That all regular growing trees, measured as above, as often as their age is increased one fourth, contain very nearly double their quantity of timber.

2. That when a tree has doubled its age, its contents will be eight-fold.

3. That when a tree has doubled its age, the annual growth will be increased four-fold.

4. Consequently, that when a tree has doubled its age, the proportion that its annual increase bears to the contents of the whole tree is then diminished one half.

For example, it appears by the last column that in the 13th year, the increase of a tree is 26·5 per cent.—in the 24th year, 13 per cent.—and in the 48th year, 6·38.

In the two preceding tables we find, that the rate of increase per cent. per annum is the same in both at the same ages, although the quantity of timber in the second table is six times as much as in the first table in trees of all ages; therefore, when the age of a tree is known, the rate per cent. per annum of its increase is known on inspecting these tables, whether the tree has grown fast or slow, provided the growth of the tree has been regular, and that it has continued its usual growth.

And having the age, girt, and height of any tree given, we can readily calculate what quantity of timber it will contain at any future period, whilst it continues its usual rate of growth.

The following table shows the number of trees to be cut out in thinning woods, and the number left standing, at every period of 4 years from 20 to 64 years, reckoning that the distance of trees from each other should be one fifth of their height, and that the trees have increased 12 inches in height and 1 inch in circumference annually, and to have been at first planted 4 feet apart.

TABLE III.

TABLE III.

Years old and feet high.	Girt.	Contents.			Distance.	Number of trees on an acre.	Contents of the whole.	Number to be cut out.	Contents.
	inch.	ft.	in	pts.	feet.		feet.		feet.
20	2½	0	10	5	4	2722	2362	839	727
24	3	1	6	0	4·8	1883	2824	494	741
28	3½	2	4	7	5·6	1389	3308	326	776
32	4	3	6	8	6·4	1063	3779	223	792
36	4½	5	0	9	7·2	840	4252	160	810
40	5	6	11	4	8	680	4722	118	819
44	5½	9	2	11	8·8	562	5194	90	831
48	6	12	0	0	9·6	472	5664	70	840
52	6½	15	3	0	10·4	402	6130	55	838
56	7	19	0	8	11·2	347	6611	45	857
60	7½	23	5	2	12	302	7076	37	866
64	8	28	5	4	12·8	265	7537		

The following table shows the same particulars as the last, in woods where the growth of trees has been 15 inches in height, and 1½ inch in circumference annually.

TABLE IV.

Age.	Height.	Girt.	Contents.			Distance.	No. of trees on an acre.	Contents of the whole.	Number to be cut out.	Contents.
years.	feet.	inches.	ft.	in.	pts.	feet.		feet.		feet.
16	20	3	1	3	0	4	2722	3402	980	1225
20	25	3¾	2	5	3	5	1742	4246	532	1296
24	30	4½	4	2	7	6	1210	5100	322	1357
28	35	5¼	6	8	4	7	888	5944	208	1392
32	40	6	10	0	0	8	680	6800	143	1430
36	45	6¾	14	2	10	9	537	7644	102	1452
40	50	7½	19	6	4	10	435	8494	75	1464
44	55	8¼	25	11	10	11	360	9355	58	1507
48	60	9	33	9	0	12	302	10192	45	1518
52	65	9¾	42	10	10	13	257	11026	35	1501
56	70	10½	53	7	0	14	222	11895	29	1553
60	75	11¼	65	10	11	15	193	12720	23	1515
64	80	12	80	0	0	16	170	13600		

The following table shows the like particulars, where the annual growth of trees has been 18 inches in height, and 2 inches in circumference.

TABLE V.

Age.	Height.	Girt.	Contents.			Distance.	No. of trees on an acre.	Contents of the whole.	Number to be cut out.	Contents.
years.	feet.	inches.	ft.	in.	pts.	feet.		feet.		feet.
12	18	3	1	1	6	4	2722	3062	839	943
16	24	4	2	8	0	4·8	1883	5021	673	1794
20	30	5	5	2	6	6	1210	6302	370	1927
24	36	6	9	0	0	7·2	840	7560	223	2007
28	42	7	14	3	6	8·4	617	8817	145	2072
32	48	8	21	8	0	9·6	472	10069	99	2112
36	54	9	30	4	6	10·8	373	11314	71	2153
40	60	10	41	8	0	12	302	12583	52	2166
44	66	11	55	5	6	13·2	250	13864	40	2218
48	72	12	72	0	0	14·4	210	15120	32	2304
52	78	13	91	6	6	15·6	178	16294	24	2197
56	84	14	114	4	0	16·8	154	17607	20	2286
60	90	15	140	7	6	18	134	18843	16	2250
64	96	16	170	8	0	19·2	118	20138		